



Sustaining Behavior Change to Enhance Micronutrient Status:

Community- and Women-Based Interventions in Thailand

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Contents

Acknowledgments	4
Introduction	5
Background	7
Conceptual Framework	9
Study Objectives	10
Design and Methods	11
Intervention	13
Research Findings	15
Discussion	22
Conclusions and Recommendations	24
References	26

Acknowledgments

We would like to express our sincerest appreciation to Dr. Frances R. Davidson (USAID), Dr. Suzanne S. Harris (OMNI Research), and Dr. Paula Trumbo (OMNI Research) for their constant encouragement and advice.

Recognition also goes to Ms. Charlotte Johnson-Welch and Dr. Kathleen Kurz, staff at the International Center for Research on Women (ICRW), and Dr. Nancy Yinger (formerly at ICRW) for their support and patience.

A special note of thanks goes to many support staff of the Institute of Nutrition, Mahidol University and the International Center for Research on Women.

Deep gratitude is expressed to all members of the project committees, local government officials, especially Mr. Yongyuth Trisutt, District Officer, and Dr. Wanchai Lausathienkit, Director of the District Hospital, and community leaders in the project area, and to Professor Kraisid Tontisirin, Mahidol University.

Lastly, our heartfelt appreciation and respect go to all the women leaders and people of the Kanthararom district. Without their belief in the project and untiring efforts to improve the nutrition and health in their communities, the intervention would not have been possible.

Introduction

Many at-risk populations in developing countries are deficient in iodine, iron, and vitamin A, making them more vulnerable to illness, fatigue, blindness, and memory loss, and increasing the possibility of mental retardation among their children. Enhancing these micronutrients can result in improved well being and physical development. Infants and pre-school children would have greater chances of survival, better health, and increased intellectual capacity. Women could have improved pregnancy outcomes and increased productivity. Supplementation, food fortification, dietary diversification, nutrition education, and food production are strategies that have been developed to reduce these micronutrient deficiencies, and have, for the most part, demonstrated positive, though uneven, results. For instance, recent data indicate progress worldwide in combating vitamin A deficiency; however, subclinical deficiencies of this micronutrient remain uncontrolled. Further, iron deficiency anemia continues to affect as many as 43 percent of women and 34 percent of men globally (ACC/SCN 1997), with widely divergent regional differences in rates. In order to virtually eliminate vitamin A deficiency by the Year 2000, and to reduce iron deficiency anemia among women of reproductive age and young children by one-third of 1990 levels, continued efforts must be made to strengthen and enhance these intervention strategies.

The International Center for Research on Women (ICRW), a nonprofit policy research institution that promotes economic and social development with women's full participation, attempted to address these issues through a two-year intervention research program implemented in five countries. Working with partners in Ethiopia, Kenya, Peru, Tanzania, and Thailand, ICRW undertook a series of studies to explore ways to strengthen women's contributions to reducing iron and vitamin A, and to a lesser extent, iodine, deficiencies by combining women's productive and reproductive activities. The idea was to tap into women's roles as income-earners and food producers on the one hand, and as food processors and care givers on the other. Community members, particularly women, drew on their knowledge and experiences to develop and implement solutions to micronutrient deficiency problems in their communities. The studies were supported by the Opportunities for Micronutrient Interventions (OMNI) Research Project, managed by the International Life Sciences Institute, and funded by the Office of Health and Nutrition, United States Agency for International Development (USAID).

The studies were conducted in Ethiopia, Kenya, Tanzania, Peru and Thailand. In **Ethiopia**, the goal was to improve vitamin A status among women and young children. Building on women's involvement in a dairy goat project, nutrition specialists worked with women's groups and elementary school teachers and students to improve food preparation and feeding practices, and production of vitamin A-rich foods. Menus were developed that used locally produced vitamin A-rich foods and the use of cooking oils to enhance absorption of vitamin A was promoted. Women, students, and teachers received seeds and were trained in techniques to expand home and school gardens. Further, health and nutrition education lessons raised community members' and school personnel's awareness of the links between food consumption and health.

In **Kenya**, a new variety of sweet potato rich in beta carotene was introduced to women farmers. The Kenya Agriculture Research Institute provided planting materials, and agricultural extension agents trained women in methods for growing and harvesting the sweet potato, post-harvest processing, and preparation techniques. In addition, health and nutrition education sessions were conducted to heighten awareness of the contribution vitamin A makes to children's health and development, and to encourage consumption of food products using the new sweet potato variety. The intention was to create supply and demand for the new food products — in the household and for market sales.

In **Tanzania**, the focus was on the adoption of new home-based solar food dryers to increase year-round availability of vitamin A-rich foods. The dryers were adaptations of earlier models and were designed to be more cost effective and accessible. Community members provided all the materials for constructing their household dryers. The research project trained local artisans to construct and maintain the dryers, and provided a short-term incentive to artisans to conduct home visits. Nutrition and health education, and business training for marketing surplus production of solar dried vitamin A-rich foods and food products complemented this technology intervention.

The **Peru** study was designed to explore the use of participatory methodologies to engage women members of community kitchens in peri-urban Lima in the design, implementation, and evaluation of a trial intervention to reduce iron deficiency among women of reproductive age. The intervention trial focused on improving the quality of service in terms of nutritional content of meals and management practices, such as instituting quality assurance checks on meal preparation and kitchen hygiene, and stimulating demand for these innovations through health and nutrition education.

This report summarizes the findings from the intervention research project implemented by Mahidol University's Institute of Nutrition in **Thailand**. The team built on experiences from an earlier social marketing intervention that increased production and consumption of the ivy gourd plant and other foods rich in vitamin A. Women who were community leaders were trained in problem-solving methods and community mobilization techniques. The women then organized their communities to develop and implement plans of action to improve iodine, iron, and vitamin A status. The project provided small seed grants to support the costs for implementing some of the community-based actions, including food production, local preparation and sale of iodized salt, and health and nutrition education.

Background

Micronutrient deficiencies, particularly iodine, iron, and vitamin A, have been the focus of much attention in Thailand in recent years due to recognition of the prevalence of these deficiencies and their human and development costs. A number of studies conducted throughout Thailand have contributed to raising the profile of these issues and demonstrating their scope and range. In 1990, a small-scale survey in the northern and northeastern provinces found a 0.1 percent prevalence of Bitot's spots¹ during the dry season with approximately one-fifth of children exhibiting subclinical vitamin A deficiency (Sinawat et al. 1991). It was also reported that vitamin A intake was low among preschool children, pregnant women, and lactating mothers (80 percent, 75 percent, and 82 percent, respectively, below the required daily allowance or RDA) in the same area of Thailand. Furthermore, fat intake was remarkably low and comprised only seven percent to 13 percent of total energy intake (Dhanamitta et al. 1988).

Iron deficiency anemia was found in 40 percent of pregnant women and 18 percent of school children in the northeast region (Nutrition Division 1991). Inadequate consumption of iron-rich foods, as well as staple foods containing iron inhibitors, and hookworm infestation were major causes of this deficiency. Finally, in 1991, prevalence of goiter, which indicates severe iodine deficiency, was reported to be 15 percent among school children in 25 provinces of the northeast and 15 provinces of the north. By 1992 the rate had fallen to 12 percent and by 1993 it was 10 percent (Ministry of Public Health 1994).

Micronutrient Activities in Thailand

As articulated in the National Nutrition Plan, the Thai government aims to eradicate vitamin A deficiency by the year 2000 (Subcommittee of Nutrition Planning 1997). Strategies the govern-

ment is using to achieve this goal include promotion of exclusive breastfeeding, supplementation in specific regions and during measles outbreaks, fortification of sweetened condensed milk, and production and consumption of vitamin A-rich foods for dietary diversification. To address iron deficiency anemia, the government has adopted a comprehensive strategy that includes iron supplementation (90 to 150 mgs of elemental iron) through health clinics for pregnant women and through schools for anemic students, fortification of widely consumed food products, and dietary diversification.

Activities to combat iodine deficiency were initiated in 1995. A national committee on iodine deficiency disorders (IDD), under the patronage of Her Royal Highness Maha Chakri Sirindhorn, developed guidelines for achieving the virtual elimination of IDD before the year 2000. Activities to control and prevent IDD include distribution of iodized salt and iodization of community and school water supplies where goiter rates exceeded five percent. Additionally, the 250 mg iodine capsule is distributed as a short-term measure in remote and highly endemic areas.

Social Marketing of Vitamin A-Rich Foods Project

To inform the implementation of the vitamin A strategy, Mahidol University undertook a three-year project (1988-1991), Social Marketing of Vitamin-A Rich Foods (SM/VAF), in the Kanthararom District (northeast Thailand)². The SM/VAF project's main goal was to reduce vitamin A deficiency by utilizing nutrition communication to change practices related to vitamin A and by creating a sustainable health promotion structure that would support the activities initiated through the project after it had ended. An end-of-project evaluation found that vitamin A knowledge, attitudes, and practices had increased signifi-

¹A 0.5 percent prevalence rate for Bitot's spots, a clinical sign of vitamin A deficiency, is the cutoff value for defining whether vitamin A deficiency is a problem of public health significance.

²The SM/VAF Project was supported by funds from the Office of Health and Nutrition, the United States Agency for International Development.

cantly (each $p < 0.05$). Further, dietary recall data revealed that consumption of the promoted ivy gourd, fats, cooking oils, and coconut milk increased, thereby contributing to significant increases in fat and vitamin A intake among target groups (Smitasiri et al. 1993). As a result, provincial and district officials adopted the SM/VAF food-based approach to improve vitamin A status among vulnerable groups (preschool and school-aged children, pregnant women, and lactating mothers). However, the project team recognized that translating their immediate success into long-term sustainable changes required greater community strength and empowerment.

Thai Women's Roles

According to Thai customs and social expectations, women enjoy a relatively favorable social status and have certain degrees of autonomy, both in their households and in their communities. Traditionally, marital relationships are considered egalitarian and women are seen as key decision-makers in determining family size, birth spacing, and childcare. Further, unlike in some Asian countries, there is less evidence of son preference in the Thai culture (Arnold 1997).

That said, Thai women face increasingly different sets of circumstance regarding work, place of residence, and lifestyle than their mothers did. These include changes in fertility, delayed marriage, and increased employment rates among women. Thailand's fertility rate³ dropped from 3.5 percent in 1980 to 1.8 percent by 1995 and contraceptive prevalence rate⁴ is currently estimated at 66 percent (World Bank 1997; Sivard 1995). These changes are mirrored by a concurrent increase in the age of marriage. In 1970, the mean age of marriage among rural women was

21.4 years, and for urban women, 24.7 years. Ten years later, the figures were 22 years and 25.5 years, respectively (United Nations, *Wistat database* version 3).

Another fundamental change in women's lives is a growth in employment opportunities -- both in the formal and informal sectors. Data from the International Labor Office (United Nations 1995) show similar patterns of economic activity rates for men and women. Between the ages of 20-24 and 50-54, slightly over 80 percent of women and 92 percent of men are economically active with similarly low (approximately 2 percent) unemployment. However, data from 1960 and 1995 show a more refined picture. In 1960, 81 percent of women and 92 percent of men were in the labor force. By 1995, however, women's participation had declined by 12 percent to 69 percent; whereas, men's had declined by only four percent to 88 percent (Sivard 1995).

Thus, circumstances are providing both greater opportunities and more constraints on Thai women's reproductive and productive lives. With fewer children and delays in marriage, women have a wider window of opportunity to stay in school, earn income, or undertake more or diversified productive activities. With more women leaving the labor market than men, women may face differential constraints in contributing to their own and their families' well being. These dynamic changes may be mitigated by the strong visible role Thai women continue to play in terms of the nutrition of their household members. Thus, the current project set out to build on and strengthen women's highly influential role in household and community-level decision-making.

³ Fertility rate is the average number of children that would be born alive to a woman during her lifetime, if she were to bear children at each age in accord with prevailing age-specific fertility rates.

⁴ Contraceptive prevalence rate is the percentage of women of child-bearing age who are using, or whose husbands are using, any form of contraception (modern or traditional).

Conceptual Framework

This intervention research study built on momentum developed in the earlier SM/VAF project. The goal of the present project was to reduce vitamin A deficiency, iron deficiency anemia, and iodine deficiency disorders in the northeast region of rural Thailand. The mechanisms for achieving this goal included training

women leaders in participatory and problem-solving methods for the purpose of developing community-based interventions and using social marketing techniques to promote and support changes in behaviors relative to the three micronutrients. Figure 1 is the conceptual framework that guided the project's planning and implementation.

Figure 1. A Conceptual Framework to Guide the Project



Study Objectives

The objectives of this project were to increase knowledge, change attitudes, and improve practices related to consumption of vitamin A and iron-rich foods, fats, vitamin C, iodized salt, and iron supplements. The expected immediate results included increased consumption of foods rich in vitamin A, iron, and vitamin C and fats, increased iron supplementation among 10-13-year-old girls, and increased household use of iodized salt. The research question was:

Could a woman-focused nutrition education and communication program based on social marketing and participatory and community-based approaches stimulate social mobilization for the prevention and control of micronutrient deficiencies over and above individual behavior changes and a focus on a single micronutrient?

The intervention district, Kanthararom, is in the northeast, the poorest region of Thailand. Its economy is heavily dependent on agriculture and is subject to alternating periods of drought and floods. Four sub-districts in Kanthararom district

were selected as the intervention sites while four other equivalent sub-districts in Kanthararom served as control sites. All of these sub-districts -- both intervention and control -- participated in the earlier SM/VAF project.

The project population included approximately 20,000 citizens living in the targeted sub-districts. The primary target group was approximately 4,000 pregnant, lactating mothers and mothers of preschool children. The secondary target group was 6,000 women of reproductive age and school girls aged 10 to 13 years. The third group was the remaining 10,000 citizens who might influence those in the primary and secondary groups.

The project used a simple quasi-experimental design. Two cross-sectional comparisons were made at the group level before and after the intervention. The sample size for each group (intervention and control) was 354 (Daniel 1987). Paired comparisons were possible for a subset of 10- to 13-year-old school girls.⁵ Simple randomization was used for the quantitative evaluation.

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⁵ Paired comparisons were not possible in the groups of pregnant or lactating women due to their varying proportions and since they were at various stages of gestation and childbirth from project beginning to project end.

Design and Methods

Overall project effectiveness was evaluated on the basis of comparisons with the control groups, and changes in knowledge, attitudes and practices relative to the three micronutrients, food consumption patterns, and serum and urine analysis for target group members. Survey questionnaires were used to measure awareness and knowledge, attitudes, and self-reported practices concerning use of vitamin A and iron-rich foods, vitamin C, fats, iodized salt, and iron supplements. Twenty-four hour recall interviews were used to assess intake of vitamin A, iron, vitamin C, and fat in pregnant and lactating women, 10- to 13-year-old school girls and young children. Biochemical analyses for vitamin A, iron, and iodine status were performed for the school girls only.⁶ Serum retinol was measured to determine vitamin A status and was analyzed using the high performance liquid chromatography method. Serum hemoglobin levels, analyzed using the cyanmethemoglobin method, and serum ferritin levels were used as indicators for iron status of school girls. Also, urine samples were analyzed for iodine status. Cutoff values for biochemical indicators are presented in table 1.

The project had four phases (see table 2). Following initial planning activities, formative data were collected on current levels of knowledge, attitudes, and practices concerning general nutrition

and local food consumption. In-depth interviews were conducted with key informants, including representatives of the primary target groups, community leaders, local government officers, and other community members who were likely to influence the adoption of the new behaviors and practices. Focus groups were conducted with women community leaders, mothers, school girls and local sub-district officials to obtain information on factors that might influence women's active participation in the improvement of micronutrient status at the community level. Finally, secondary data sources were reviewed to fill informational gaps and provide contextual and background information.

Phase 2 also included collection of baseline data. This was followed by phase 3 in which women leaders were identified and trained and the trial interventions were designed. Women leaders (up to 64) were identified through a process of observation at the community level and discussions with the women, their communities' leaders, and relevant local government officers.

Three conceptual models guided the design of the intervention phase. The social marketing model and principles were used to influence the adoption of new "products", in this case, social ideas and behaviors (Kotler 1980; Andreasen 1988;

Table 1. Definitions of nutrient "deficiencies" using biochemical indicators

Deficiency	Indicator	Cut-off point or ranges
Iron deficiency anemia	Hemoglobin	≤ 12 g/dl
	Serum ferritin	≤ 10 ng/ml
Iron depletion	Serum ferritin	≤ 20 ng/dl
Vitamin A deficiency (VAD)	Serum retinol	≤ 30 μ g/dl
VAD (moderate)	Serum retinol	10-20 μ g/dl
VAD (mild)	Serum retinol	20.01-30 μ g/dl
Iodine deficiency (severe)	Median urine iodine	≤ 2 μ g/dl

⁶ This group was chosen for more detailed study given the relative ease in following them over time — all were in school and less mobile than older women.

Table 2. Project implementation (September 1996 – December 1997)

Phase	Activity	Dates
Phase 1	Project preparation	September – November 1995
Phase 2	Formative data collection	December 1995 – February 1996
	Baseline data collection including KAP survey	March – May 1996
Phase 3	Identification women leaders	June 1996
	Training, community-based interventions	June 1996 – February 1997
	Iron supplementation (schools)	January – March 1997 (12 weeks)
Phase 4	Serum levels (school girls)	March 1997
	Evaluation data collection	March – April 1997

Lefebvre and Flora 1988). The other models contributed to designing the intervention activities that aimed to strengthen community women's leadership abilities -- Cornell Modified Community-Based Nutrition Monitoring (CBNM) (Pelletier et al. 1994) and the Appreciation-Influence-Control (A-I-C) Process (Smith and Landais 1991; Smith, Francis and Thoolen 1980).

Throughout the intervention phase, process data were collected for the purpose of monitoring whether the project was being implemented as planned and where adjustments were needed. These data were collected through regular meetings with women leaders and local government officers by the project team, student volunteers, and project field coordinators.

The final phase of the project was its evaluation. Baseline and post-intervention data for both control and intervention groups were compared, and the effects of women leaders' roles in stimulating changes in micronutrient deficiencies in their communities were assessed. Moreover, their effect on iron supplementation for school girls and local production and sale of iodized salt was also examined. The comparison between control and intervention sites permitted the research team to assess which set of interventions -- the previous project's activities alone (control sites) or current project's activities plus the previous project's activities (intervention sites) -- had a greater effect on vitamin A, iron, and iodine status.

Intervention

This study built on behavioral changes achieved by the SM/VAF project by engaging women at a local level in leading their communities to address micronutrient deficiencies. The intervention had two stages: first, training the women leaders in problem-solving methodologies and techniques for community mobilization, and second, designing and implementing community-based actions to address the nutritional deficiencies.

Training Women Leaders

As noted above, two models guided women leaders' training in problem-solving methodologies and how to apply those methods in the development of community action plans -- the CBNM and the A-I-C approach. The CBNM focuses on problem identification followed by the analysis of causes, potential solutions, and the decision-making process. As used in this project, the organizational structure began with a **taskforce** of diverse stakeholders and decision-makers at the district and sub-district levels. A **core group** of women leaders was configured for the purpose of leading community level action. In addition, a **parent group**, made up of external technical experts from outside the communities and other resource persons, was organized to support the core group. Community advisory groups of seven to 22 members (180 total among the intervention communities) also were organized to provide support to the women leaders.

The A-I-C approach was used to guide the three-day training of the women leaders. The appreciation session (A) was designed to raise the women's awareness of their roles as leaders, how they make decisions and take action. Slides and videos were used to illustrate the current food and nutrition situation and to increase the women leaders' understanding of the essential contributions that food and nutrition make to human resource and national development. The women were challenged to analyze their particular communities' situation.

The influence session (I) encouraged the women leaders to accept personal responsibility for their roles in community development. They developed their own definitions of what they would like their communities to be (their "ideal") and the activities or projects that would permit those ideals to be achieved. They then defined the rationales and consequences of those activities and prioritized them relative to their potential for achieving better nutritional outcomes.

The control session (C) transformed the development needs and ideals into action. The women leaders formulated their own action plans and identified whose participation would be necessary for assuring its implementation. Following the training sessions, project team members visited the women leaders to provide additional support for mobilizing their communities. One-day mini "A-I-C" workshops also were held in each intervention sub-district with the core group members and community advisors.

Community-based Interventions

Because of the influence of the earlier social marketing project, many of the interventions in the new project focused on reinforcing activities that were promoted in that project. These included encouraging consumption of leafy green vegetables, animal liver, and eggs for vitamin A and production of vitamin A-rich foods such as the ivy gourd, poultry, and rabbits. Similarly, because the earlier project had increased community members' awareness and knowledge of vitamin A's contributions to good health and nutrition, the current project served to remind and encourage community members to act upon these messages and extend them to include iron and iodine intakes.

Applying social marketing principles, the research team worked with the women leaders to provide nutrition, health, and development information through every-other-day broadcasts using commu-

nities' public announcement systems. Community billboards encouraged consumption of leafy green vegetables and the use of iodized salt. Mailings prepared by the research team kept district advisory committee members, sub-district council members, women leaders, community advisors, pregnant and lactating women, and the sub-district taskforce informed as to the progress made in designing and implementing community action plans.

School-based nutrition education campaigns targeted 10- to 13-year-old school girls. Health and nutrition messages were incorporated into classroom work. A bulletin board contest motivated the girls to create nutrition education messages using their newly acquired knowledge and students used school broadcasts to disseminate their messages. Other school-based activities included improving the nutritional content of school lunches by incorporating micronutrient-rich food sources into the menus and promoting such activities as poultry raising, fish ponds, and vegetable gardens. Finally, an iron supplementation trial using 60mg ferrous sulfate tablets, purchased⁷ by the girls' or their parents, was introduced in the latter stages of the intervention phase. Girls received one tablet per week for 12 weeks.

To make iodized salt more available, women's groups obtained iodine drops from the district level government at no cost and mixed this with non-iodized salt. This cost less than salt iodized at a factory. The groups sold this community-produced iodized salt to community members, keeping some of the profits to support other group activities. Broadcasts and other media were used to increase the communities' awareness of how to prevent IDD, its causes and consequences.

In order to support the communities' action plans, the project provided seed grants to 15 communities in amounts ranging from US \$83 to US \$139 (3000 to 5000 baht). These funds were disbursed one month after the final A-I-C workshop and in response to the action plans developed by the women leaders and their communities. In addition to the seed grants, the project provided materials in the form of nutrition, health, and development messages; gave technical support to the women leaders; and took the women leaders on a local study tour to observe innovative farming practices. As noted above, iodine drops were an in-kind contribution from the district health office.

Photo courtesy of Institute of Nutrition, Mahidol University



⁷ A one-month supply of four tablets cost only one baht (approximately 3 US cents).

Research Findings

This section summarizes the findings from the set of community- and school-based interventions designed to reduce iodine, iron, and vitamin A deficiencies. It begins with results measured by changes in knowledge, attitudes, and practices, followed by nutrient intake and biochemical indicators. Comparisons are presented between communities and over time. When data exist for the same school girls before and after the intervention in both sets of communities, these are highlighted. The section concludes with a report of how the results were used to inform and influence key decision-makers through an advocacy campaign.

Change in Knowledge, Attitude, and Practice

Scores in knowledge, attitude, and practice (KAP) relative to vitamin A, vitamin C, iron, and iodine were analyzed for change between groups and over time. Table 3 reports these changes, as well as levels of significance. Scores were assessed for 369 adults in 1996 and 271 in 1998 in the intervention communities, and 349 and 247 at baseline and post-intervention in the control group.

For vitamin A and iron, knowledge, attitude, and practice scores were significantly higher after the

Table 3. Mean scores by micronutrient for intervention and control groups before and after the project intervention

Areas/Micronutrient	Mean knowledge scores		Mean attitude scores		Mean practice scores	
	1996	1997	1996	1997	1996	1997
Vitamin A						
Intervention	7.4	8.9 ^{a,x}	32.3	35.6 ^{a,x}	5.5	6.4 ^{a,x}
Control	7.7	7.8	32.9	34.0 ^b	5.8	5.9
Total possible scores:	16		40		10	
Iron						
Intervention	7.2 ^y	8.7 ^{a,x}	34.7	37.4 ^{a,z}	9.7	7.2 ^{a,x}
Control	7.5	6.3 ^a	35.3	36.7 ^a	9.7	6.9 ^a
Total possible scores	19		40		12	
Vitamin C						
Intervention	6.0 ^y	7.2 ^a	29.4	31.7 ^a	10.0	10.1
Control	6.4	6.4	29.3	30.9 ^a	9.9	10.1 ^b
Total possible scores	12		40		13	
Iodine						
Intervention	9.2 ^y	9.8 ^a	34.2	36.4 ^{a,x}	3.5 ^x	3.5 ^x
Control	9.7	9.6	33.8	34.8 ^b	3.1	3.0
Total possible scores	15		40		6	

Statistical test by Group t-test between 1996 and 1997 in each area:

^a $p < 0.0001$ ^b $p < 0.0$

Statistical test by Group t-test between intervention and control in each year:

^x $p < 0.0001$ ^y $p < 0.01$ ^z $p < 0.0$

intervention compared to the control group and the intervention group at baseline. The exception was iron practice scores that dropped in both the intervention and control groups. This may reflect households' constraints that limit their ability to act on their knowledge and attitudes. Formative data suggest that these include limited access to certain micronutrient-rich foods or traditional food consumption beliefs and patterns in the communities. Further, there is often a consistent lag between changes in knowledge and attitudes and acting upon those changes (Ross and Mico 1980). Thus, more change in practice scores might be seen over time if continued reinforcement was given and if barriers to change were reduced.

Nutrient Intake

Overall, the basic diet in northeastern Thailand consists of a glutinous rice-based staple served three times a day. Meals may include other foods depending on their availability, but these tend to serve as condiments for the rice-based meal instead of substantial independent portions. The main food preparation methods used in this region are grilling, boiling, steaming, and stir-frying. There is very little frying with fat, only for preparing meats and eggs when mixed with vegetables. The earlier project showed that the main constraints to diversified diets were family purchasing power and a limited supply of meat (Smitasiri et al. 1992).

Vitamin A intake. The 24-hour recall results revealed that all four groups—two- to five-year-old children, 10- to 13-year-old school girls, pregnant women, and lactating women—in both intervention and control groups increased their consumption of vitamin A-rich foods during the project period. Further, for all groups except the young children, the change over time in the intervention group was noticeably greater than their control counterparts. That said, the improvements among the different control groups are not easily explained even when taking into account their involvement in the previous project and, perhaps, some spillover effect from the current intervention sites. Continued efforts are needed to explore why they were able to improve their intake with no additional inputs.

The greatest changes were seen in the two- to five-year-old groups (both intervention and control) whose consumption of vitamin A-rich foods increased from 80 percent of the recommended daily allowance (RDA) for that age group in 1991 (end of the SM/VAF project) to 133 and 101 percent in 1996 for intervention and control groups, and then to 142 and 158 percent, respectively, by 1997 (see tables 4 and 5) (Smitasiri 1994). It is important to recall that the adult respondents' scores for knowledge, attitude, and practice relative to vitamin A improved significantly. Thus, adults may have chosen to act

Table 4. Intake of vitamin A, fat, iron, and vitamin C as percent of recommended daily allowance

Nutrient	Year	2-5 years		10-13 years		Pregnant		Lactating	
		Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control
Vit A	1996	133	101	41	38	44	48	32	33
	1997	142	158	72	59	89	64	71	47
Fat ^a	1996	18	17	12	13	12	12	8	10
	1997	21	22	16	14	10	10	12	8
Iron	1996	65	55	51	63	25	26	73	73
	1997	63	73	65	59	31	32	106	103
Vit C	1996	14	14	48	42	60	48	29	39
	1997	19	19	48	56	62	53	46	45

^aIn the case of fat, the RDA equivalent is the percent of total calories from fat.

Table 5. Significant changes in vitamin A, fat, iron, and vitamin C intake among target groups (1996 compared to 1997)

Nutrient	2-5 years		10-13 years		Pregnant		Lactating	
	Intervention	Control	Intervention	Control	Intervention	Control	Intervention	Control
Vitamin A	↑	↑	↑	↑	↑	—	↑	↑
Fat	—	—	—	—	—	—	—	—
Iron	—	↑	↑	—	—	—	↑	↑
Vitamin C	—	—	—	↑	—	—	↑	—

↑ = Significant increase ($p < 0.05$ or greater)

↓ = Significant decrease ($p < 0.05$ or greater)

— = No significant change

on those changes by focusing their efforts on improving their children's vitamin A intake.

Fat intake. Intake of this nutrient among all groups was remarkably low and with little difference between the intervention and control groups for each of the target populations at both points in time (see tables 4 and 5). The increases that did occur were not significant and never reached the recommended level of 20 to 30 percent of total calorie distribution (Hultman, Thomson, and Haris 1988). Given consistent lack of change across age groups, this limited intake may be a reflection of the inaccessibility of fat sources in these households, particularly the high cost of purchasing cooking oil and meats, both good sources of dietary fat. Earlier research indicated a historically low intake of fat in the same (northeast) region of Thailand, between seven and 13 percent of total energy intake (Dhanamitta, Viriyapanich, and Kachonpadunkitti 1988). Nonetheless, Kamtrakul reported that fat intake of at least ten percent of total calorie intake can be sufficient for absorption of vitamin A (Kamtrakul 1988).

Iron intake. A significant increase in iron intake during the project (see tables 4 and 5) was seen only in the two- to five-year-old control group, the 10- to 13-year-old intervention group, and lactating women in both control and intervention groups. In addition, only the lactating women reached their required daily allowance for this critical nutrient. Iron intake was particularly low

among pregnant women, indicating a possible need to intensify efforts to improve dietary iron intake during pregnancy. The increase in iron among the two- to five-year-old controls with no change among the intervention groups is somewhat inexplicable. As in the case of the vitamin A improvements among control groups, additional efforts are needed to explore why this may have occurred.

Although meat and other heme-iron foods are recognized as nutritious and good for health and development, the lack of change in most groups could be a consequence of households having limited resources that constrain their abilities to purchase those more expensive iron sources. Further, formative data indicated that dietary beliefs and food restrictions for some groups such as pregnant women (e.g., pregnant women are discouraged from eating meat and eggs), limit their access to these foods. Although many traditional food beliefs are thought to be on the decline in this region, they are still promoted by elderly community members and might have influenced pregnant women's iron intake (Smitasiri et al. 1993). Finally, it is important to refer to the knowledge, attitude, and practice scores in table 3. In the case of iron, both knowledge and attitude improved significantly for the intervention and control groups, while there was a drop in practice scores among both groups. This supports the inconsistent results in terms of intake and suggests that additional efforts should focus on translating positive knowledge and

attitudes regarding intake of this important nutrient into actual consumption and addressing constraints households face in purchasing these higher-priced foods.

Vitamin C intake. As was the case with fat intake, intake of vitamin C, which enhances the absorption of iron, was low in most of the population groups, and particularly so for the youngest children. Pregnant women were the only intervention group who met at least half of their required daily allowance. Conversely, it was only the lactating women in the intervention group whose vitamin C intake increased significantly over time, although never surpassing 50 percent RDA. The fact that lactating women's iron intake also increased significantly suggests there may be some opportunity to improve the overall diet quality of these women and their breastfed infants. Formative data suggest that physical and economic inaccessibility to vitamin C-rich foods may explain some of the lack of consistent improvement in both intake and knowledge, attitude, and practice scores over time and between groups.

Use of iodized salt. Iodized salt intake was assessed by self-reported consumption of iodized and non-iodized salts, and use of iodized salt in cooking, and confirmed by checking availability of iodized salt in the household. There were consistent improvements among the intervention group households for each of these indicators. Further, while there were increases in availability of iodized salt in both intervention and control households, the increase was significant ($p < 0.01$) only among the intervention households (from 43 percent at baseline to 58 percent at post-intervention). Intervention households also demonstrated a slight (but insignificant) increase in their consumption of iodized salt over time (from 38 percent to 41 percent) and a significant ($p < 0.01$) decrease in their use of non-iodized salt (from 36 percent to 17 percent) over the course of the study. This is in contrast to a remarkable drop in self-reported consumption of iodized salt among control households (from 50 percent to 19 percent) and an increase in their

consumption of noniodized salt (24 percent to 42 percent) over the one-year intervention period. Finally, there was a significant difference ($p < 0.01$) between intervention and control groups' reported use of iodized salt in cooking (72 percent and 40 percent respectively) at the end of the intervention phase.

These results reflect the improvements in knowledge and attitude scores reported earlier. Formative data suggested that there were external constraints, including limited availability of iodized salt and its high cost, that constrain households' abilities to purchase and use this salt. It was for these reasons that the project developed an alternative that could be produced locally, and was cheaper and more accessible than the factory-produced iodized salt. Urine analysis results described below suggest that, in fact, this effort to improve households' access to iodized salt may have improved iodine status.

Biochemical Indicators

Serum samples were drawn to assess vitamin A (serum retinol) and iron status (hemoglobin and serum ferritin) among school girls both before and after the intervention, and urine samples for the same sample set were collected to assess iodine status. The following are results for paired comparisons of a subset of school girls (10 to 13 years old) in the control and intervention groups. Table 6 reports data on micronutrient status. Subsequent tables (see tables 7-9) report prevalence-level data.

Vitamin A status. As seen in Table 6, serum retinol levels for the intervention group improved significantly. Further, the positive change that occurred among the intervention group was significantly better than the change in the control group. Moreover, the intervention group started at a lower value than the control group.

The improvement in serum retinol levels is reflected in a statistically significant reduction in the prevalence of vitamin A deficiency ($< 30 \text{ } \mu\text{g/dl}$) among schoolgirls in the intervention (see table 7). Thus, for vitamin A, KAP scores, nutrient intake,

Table 6. Average vitamin A, iron, and iodine status for school girls 10 - 13 years, before and after intervention¹

	Intervention				Control			
	n	1996	1997	Difference ²	n	1996	1997	Difference ²
Serum Retinol Levels $\mu\text{g/dl}$	42	22.8 (6.9)	33.7 ^a (8.3)	+10.9	36	26.5 (6.9)	29.8 (6.7)	+3.3 ^c
Hemoglobin Levels g/dl	87	12.8 (1.5)	13.1 (1.2)	+0.3 (1.58)	77	13.4 (1.7)	13.1 (1.4)	-0.2 (2.0)
Serum Ferritin Levels ng/ml	56	45.6 (4.0)	85.1 ^b (5.1)	39.4 (4.6)	45	47.1 (4.0)	54.9 ^a (3.3)	7.7 ^d (2.5)
Urine Iodine Levels $\mu\text{g/dl}$	74	9.2 [0.0-93.3]	12.6 [1.5-41.3]	–	70	12.4 [0.0-66.1]	12.7 [1.8-48.7]	–

¹ Mean (\pm SD) [range]

² (1997 values) – (1996 values)

^a $p < 0.001$ (t-test)

^b $p < 0.0001$ (t-test)

^c Statistically significant than intervention group difference, $p < 0.001$, t-test

^d Statistically significant than intervention group difference, $p < 0.0001$, t-test

and serum levels all showed consistent improvement. They suggest that the women leaders' promotional efforts to improve production and consumption of vitamin A-rich foods, in addition to a foundation of knowledge from the previous project, may have contributed to reducing vitamin A deficiency among these girls.

Iron status. Eighty-seven girls in the intervention group and 77 in the control group had blood drawn for hemoglobin analysis. A subset of these (56, intervention; 45, control) also had serum ferritin analyses conducted.

Mean hemoglobin values in the intervention group increased, although not significantly, over the one-year intervention period as compared to a slight decrease in the control group's levels (see

table 6). Prevalence of anemia (hemoglobin levels < 12 g/dl) decreased from 25 percent in 1996 to 16 percent in 1997 for the intervention group, while it remained unchanged in the control group (25 percent). The lack of statistical significance in the intervention group may be explained by the small numbers of girls with hemoglobin values less than < 12 g/dl -- 22 girls in the intervention group in 1996 and 14 in 1997.

Serum ferritin results confirmed these positive findings (see table 6). Even more, while each group showed significant improvements, the intervention group improved to a greater degree. As was the case in vitamin A status, there also was a significant difference between the changes in the intervention group and the control group.

Table 7. Distribution serum retinol levels among school girls 10-13 years, before and after intervention

	Intervention (n=42)		Control (n=36)	
	1996	1997	1996	1997
Moderate Deficiency (10.0 – 20.0 $\mu\text{g/dl}$)	41%	2% ^a	14%	8%
Mild Deficiency (20.01 – 30.0 $\mu\text{g/dl}$)	50%	38%	58%	47%
Total Deficiency (<30.0 $\mu\text{g/dl}$)	91%	40% ^a	72%	55%

^a $p < 0.0001$ (Fishers exact test)

Table 8. Iron depletion among school girls 10-13 years old, before and after intervention

	Intervention (n=56)		Control (n=45)	
	1996	1997	1996	1997
Serum Ferritin <20 ng/ml	16%	0% ^a	4%	4%
Serum Ferritin <10 ng/ml	5%	0% ^b	2%	0%

^ap<0.001 (Proportions test)

^bp<0.05 (Proportions test)

The intervention group showed a significant reduction while the control group showed little or no change (see table 8). Put in a positive light, there were statistically significant ($p < 0.001$) improvements in the percentage of school girls with adequate (> 60 ng.ml) iron levels--from 23 percent to 77 percent--while there was no significant change in the control group--from 22 percent to 38 percent.

These positive improvements in both hemoglobin and serum ferritin levels in the intervention group could have been influenced by women leaders' efforts to promote production and consumption of iron-rich and iron-enhancing foods, as well as improvements in nutritional content of school lunches and weekly administration of 60 mg ferrous sulfate tablets for 12 weeks. As the study was designed to test a package of community-based interventions, the researchers could not separate out the relative contributions of different components of the intervention. That said, significant improvements in knowledge and attitude scores and in intake of iron-rich foods suggest that the promotion and food consumption efforts likely contributed to the improvement in

iron status of school girls in addition to the iron supplementation.

Iodine status. Median urine iodine (UI) levels increased among the intervention group only (see table 6). It should be noted that the intervention group had much lower urine iodine values than the control group at the beginning of the intervention.

Data presented in table 9 suggest that while iodine deficiency is a problem in the study area, the intervention succeeded in significantly reducing the prevalence of this deficiency. Although the control group was less deficient than the intervention group both before and after the intervention, by the end of the intervention, the intervention group's urine iodine level equaled that of the control group. This improvement is quite remarkable given that it is principally a result of women leaders' promotion efforts to increase community awareness of the importance of consuming iodized salt as well as to produce iodized salt in their communities. This suggests that reductions in iodine deficiency can be achieved without depending entirely on availability of factory produced iodized salt.

Table 9. Distribution of urinary iodine (ug/dl) among adolescent girls 10-13 years old, before and after intervention

Urine Iodine Cutoffs	Intervention		Control	
	1996 (n=74)	1997 (n=74)	1996 (n=70)	1997 (n=73)
UI < 10µg/dl	51%	42%	41%	32%
UI < 5 µg/dl	19%	15%	10%	14%
UI < 2.0 µg/dl	8%	1% ^a	3%	1%

^ap < 0.05 (Proportions test)

Advocacy Component

An advocacy component was built into this project as a means to use the research results to inform decision-makers and stimulate their commitment to take action based on the results. The objectives of this activity were to:

- ▶ Publicly recognize the contributions community women's leadership made to achieving improvement in the nutritional status of key population groups;
- ▶ Expand the project's activities to 12 other sub-districts; and
- ▶ Encourage officials at the district level in Kanthararom and nine other districts of Si-Saket and Ubon-Ratchatani Provinces to provide support to similar provincial-level programs in the future.

A workshop was held one month before the conclusion of the project (November 1997) and brought together a total of 113 participants -- women leaders, sub-district executive committees, project advisory committee members, sub-district and district officials from the intervention district as well as district officials from neighboring districts. Key messages that were relayed included:

- ▶ Health and nutritional improvements of community members are essential for development;

- ▶ Such improvements can be initiated from within communities;
- ▶ Women are critical actors and decision-makers in this process;
- ▶ Substantial improvements can be sustained with the support of district level leaders; and
- ▶ The implementation of this approach is supported by the current National Socio-economic Plan.

In a series of five sessions, participants were presented with information about linking nutrition and quality of life; sharing women leaders' experiences in resolving micronutrient deficiencies, reinforced by updated scientific information and a case study on lessons learned from a successful participatory community based development program; and training in developing strategies and action plans to achieve nutrition and health improvements. The outcomes of this advocacy activity were community action plans and strategies that were endorsed by the district-level decision-makers. For instance, the sub-district council members agreed to support the extension of the activities to all villages in their areas and to appoint women to the subdistrict councils.

Discussion

This project built on an earlier project that achieved measurable improvements in knowledge, attitude, and practice related to vitamin A, and which had created a favorable environment for constructing the current intervention research study. The new project focused on training women leaders in problem solving techniques and methods of mobilizing their communities for action and expanding the focus from one micronutrient (vitamin A) to three (vitamin A, iron, and iodine). The study intended to explore the feasibility and effects of activities initiated by communities under the leadership of community women to improve vitamin A, iron, and iodine status among key population groups. Its implementation included ten months of planning and data collection (September 1995 to June 1996) followed by nine months of intervention (July 1996 to March 1997).

Nutritional Changes

Outcome (KAP scores and nutrient intake) and impact (biochemical indicators) measurements indicate that this women-led, community-centered participatory process contributed to improvements in vitamin A and iron intake and status. It is remarkable to note that these results were achieved principally through interventions that were implemented over a nine-month period and were promotional in content complemented by the sale of locally-produced iodized salt to community members and a 12-week iron supplementation trial with school girls.

Improvements in vitamin A indicators were consistent for more groups than the other nutrients (iron, fat, and vitamin C). This may have been a result of the cumulative effects of the earlier social marketing project and the current project which promoted the consumption and production of vitamin A-rich foods. Or it may be the improvement in vitamin A intake, in particular,

is feasible for community members given that these foods are typically not expensive to produce or purchase.

While there were marked improvements in iron intake and iron status for school girls, there were mixed results in terms of iron intake for other groups, e.g., lactating women in both control and intervention groups significantly improved their intake of iron, but there were no significant changes in intake among pregnant women. There were improvements in iron intake among two to five year olds in the control but not the intervention group. This merits continued examination as there are no readily apparent explanations for this paradoxical outcome.

The positive changes in different indicators of iron and iodine status also suggest that certain groups of the study population may have reached a level of readiness to incorporate new messages or new behaviors. For instance, the consistent improvement in KAP for iron and the increase in iron intake among lactating women and school girls, corroborated with serum levels for the school girls, may be suggestive of their readiness for change. It is also notable that the changes in lactating women's iron intake came after an intervention that was principally promotional, that is, did not include supplements. Improving their nutrient intake would likely contribute to improving the nutrient intake of their breastfeeding children, thereby, multiplying the beneficiaries of this community-based effort. That said, the lack of change in iron intake for young children and pregnant women suggest that readiness can be selective; that is, change does not necessarily occur simultaneously or at the same rate for all groups.

On the other hand, the literature suggests that while behavior change often follows on changes

in knowledge and attitude, it also is dependent on enabling factors, such as income to purchase relevant goods and services, and reminders to continue to use newly-adopted practices (Ross and Mico 1980; Green et al. 1980). This may be particularly relevant in terms of iron, fat, and vitamin C intake. Formative data suggest that a likely limiting factor to consumption was economic and physical inaccessibility to foods rich in these (and other) nutrients. Thus, in an area that is highly dependent on agriculture and relatively poor, improving or diversifying household income might be the most strategic means to improve household members' nutritional well being. In addition to economic constraints, food beliefs may persist for specific groups such as pregnant women, and these may limit access to key nutrients. In that case, developing actions to reduce these beliefs may be an efficient intervention strategy.

School girls was the only group for whom there is a complete set of data--intake and serum and urine levels. Although the sample sizes were relatively small for the biochemical indicator data, it is important to note the consistency across the type of data and across micronutrients in terms of the positive change over time. It should be recalled that this group received inputs that other

groups did not – specifically enriched school lunches and iron supplementation. Further, because the study was designed as a comprehensive, integrated package of interventions, it is difficult to attribute each intervention's contributions to iron status improvement. Nevertheless, the results suggest promising avenues for improving the nutrition of this vulnerable yet maturing population group.

Finally, the nutrition results suggest that training women in leadership skills and techniques had a certain pay off. Women leaders worked in their communities to promote consumption of vitamin A- and iron-rich foods and local production and sale of iodized salt. Thus, nutritional benefits were due, at least in part, to the women leaders' time and effort. While there is a strong Thai tradition of community volunteerism (e.g., mobilizing volunteers to serve as community health agents) and this may have contributed to the success of the interventions, there is nevertheless evidence that suggests that opportunity costs for volunteers are common across regions and countries (Guijt and Shah 1998). It would be worth exploring the relevance of this issue to the Thai setting and possibly identifying additional means to support women's efforts to improve the health and nutrition of their communities.

Photo courtesy of Institute of Nutrition, Mahidol University



Conclusions and Recommendations

Results show that within the two-year period, nine months of which were dedicated to the intervention, significant nutritional benefits were achieved through this women-led, community-based intervention research study. The following recommendations are made:

■ Address Multiple Micronutrients Simultaneously:

This project focused on increasing knowledge and promoting practices that improve vitamin A, iron, and iodine status, and the data suggest varying degrees of success. Promoting production and consumption of vitamin A-rich foods resulted in improvements in vitamin A status as measured by serum retinol for school girls. Lactating women increased their intake of both vitamin A-rich and iron-rich foods. Weekly iron supplementation plus increases in consumption of iron-rich foods by school girls reduced iron deficiencies as measured by hemoglobin and serum ferritin levels. Finally, increased economic and physical accessibility to iodized salt led to measurable improvements in urine iodine levels for school girls.

These results suggest that expanding the focus of an intervention beyond one nutritional element is feasible within a community setting. Further, targeting activities to those groups who have demonstrated a readiness for change, e.g., lactating women, can increase the efficiency of the type of interventions. Thus, it is recommended that program planners and practitioners consider developing multi-focus interventions as long as there are sufficient funds made available to:

- ▶ Provide necessary inputs (e.g., materials and equipment, as well as technical expertise) and support to communities so they can implement their action plans; and
- ▶ Reinforce promotional messages over time.

Furthermore, recognizing that changes occur over time and at a different pace for different groups, sufficient resources should be made available over the long term to allow for maximum adoption of recommended practices. And finally, those factors that constrain individual decision-making and limit options at the household level, including financial constraints, should be addressed.

■ Select Appropriate Venues to Reach Youth:

School-based promotion of production and consumption of micronutrient-rich foods, enrichment of meals provided by the school, and supplementation with ferrous sulfate were the interventions used to improve iron (and other nutrients) status among school girls. Data show consistent improvements across all indicators for this particular target group. These results hold promise for those who seek to improve the nutritional status of young girls before they enter into their reproductive years. Further, the supplements were affordable (3 US cents per 4 tablets), thereby enabling parents to provide their daughters access to an intervention that would enhance their health and well-being.

Where anemia rates suggest the need for iron supplementation for young girls; where school enrollment rates among this age group of girls are reasonably high, and where reliable supplies of iron supplements are available, nutrition and health planners and practitioners should consider implementing school-based iron supplementation programs for at-risk school girls. Furthermore, schools should also undertake activities that promote good health and nutrition practices, including developing and disseminating health and nutrition education messages to all adolescents — boys and girls.

■ **Support Women as Community Leaders and Change Agents:**

Strengthening women leaders' skills in community organization and mobilization appeared to contribute to the success of this study. While the Thai culture already encourages and supports women's contributions to their

communities, the opportunity costs and benefits women derive from these leadership positions should be assessed. Once these benefits and costs are articulated, concrete actions should be taken when designing and implementing projects that engage women in community leadership roles.

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The publication of this report is made possible by support from Opportunities for Micronutrient Interventions (OMNI) Research, a project of the Office of Health and Nutrition, Bureau for Global Programs, Field Support and Research, U.S. Agency for International Development (USAID), under cooperative agreement HRN-5122-A-00-3046-00. The information presented herein does not necessarily reflect the scientific recommendations or views of OMNI Research, the USAID, or the International Life Sciences Institute (ILSI).